Section 1. Introduction

Engineering/Remediation Resources Group, Inc. (ERRG) has prepared this Remedial Design (RD) for Operable Unit (OU)-1, the Meyers Landfill Site, in El Dorado County, California. This RD is being developed under the U.S. Department of Agriculture Forest Service (Forest Service) Regional Environmental Response Action Contract (AG-91S8-C-06-0056) Activity V, Task 2. The proposed RD for OU-1 includes the design of (1) a new cap system for the landfill that minimizes infiltration through the waste, controls surface water runoff, and controls potential erosion from the cap; (2) a new French drain; and (3) a passive landfill gas (LFG) emissions control system. The RD for OU-1 is based on the remedy (Alternative 3) evaluated in the Supplemental Remedial Investigation/Feasibility Study (RI/FS) Report (Weston Solutions, Inc. [Weston], 2007) and selected in the Record of Decision (ROD) for OU-1 (Forest Service, 2007).

The Forest Service is the lead agency pursuant to its delegated authorities under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended, and Executive Order 12580.

1.1. PURPOSE, GOAL, AND SCOPE

In 2006, the Meyers Landfill Site was separated into two OUs (OU-1, the landfill waste mass, and OU-2, the groundwater plume) to accelerate selection and implementation of a containment remedy for the landfill waste mass. This RD addresses the remedy for OU-1 only. The remedy for OU-2 is being evaluated separately by the Forest Service and is not discussed further in this report.

The purpose of the RD is to prepare a plan that implements the remedy selected in the ROD issued in November 2007 (Forest Service, 2007). The selected remedy is a new landfill cap system that will meet the following remedial action objectives (RAO) for OU-1:

- Landfill area: Protection of humans and wildlife from exposure to landfill refuse and soil contamination by eliminating exposure pathways and contaminant migration.
- Source area groundwater: Minimization of the effects of landfill refuse and soil contaminants on groundwater quality (e.g., rainwater infiltration) and rainwater runon.
- LFG: Protection of humans and wildlife by minimizing exposure pathways and gas migration.

The objective of the RD for OU-1 is to protect humans and wildlife while allowing reuse of the property in accordance with the Land Use Control (LUC) RD (Appendix A) and the LTBMU Land and Resource Management Plan (Forest Plan) (Forest Service, 1988).

1.2. PROJECT DESCRIPTION

The following background information on the Meyers Landfill Site and OU-1 is from the Forest Service's Statement of Work (provided to prospective bidders under the aforementioned contract dated April 7, 2008), the RI/FS Report (Weston, 2007) and the ROD (Forest Service, 2007).

The Meyers Landfill Site is located approximately 1.9 miles northeast of the town of Meyers on National Forest System lands within the Forest Service Lake Tahoe Basin Management Unit (LTBMU), El Dorado County, California (Figure 1).

The Meyers Landfill Site is a closed waste disposal site bounded on the west by the paved Forest Service Road 12N08, also known as Garbage Dump Road. The site is bounded to the north by an active electrical substation operated by Sierra Pacific Power Company, to the east by Saxon Creek, and to the south by the intermittent stream valley, in which the landfill was constructed. The disposal site and the area surrounding it form a relatively flat plateau of approximately 17 acres (Figure 2).

The landfill operated from about 1947 through 1971 under a series of Forest Service special use permits that were issued to private parties and El Dorado County (County). Waste disposed of at the landfill included solid waste from residential and commercial sources from within the Lake Tahoe Basin area. The landfill stopped receiving waste in 1971. Between 1972 and 1973, the County closed the dump and placed an interim cover over the waste.

1.3. REPORT ORGANIZATION

This Final (100%) RD is organized as follows:

- Section 1: Introduction, describes the project, background information, environmental setting, land use, and results of previous investigations.
- Section 2: Removal Action Objectives, Design Criteria, and Constraints, summarizes the site-specific cleanup goals and applicable or relevant and appropriate requirements (ARARs)
- Section 3: Engineering Design, summarizes the basis of design and describes the design elements.
- Section 4: Implementation, summarizes potential environmental impacts and mitigation measures and provides an overview of the construction quality assurance (CQA) process and engineering cost estimate.
- Section 5: References, lists the documents used to prepare this RD.

Appendices include the Draft LUC RD (Appendix A), Pre-Design Field Investigation Report (Appendix B), calculations (Appendix C), results of the geotechnical stability analysis and infiltration analyses (Appendix D), design drawings (Appendix E), design specifications (Appendix F), CQA Plan (Appendix G), Operations, Maintenance, and Monitoring (OM&M) Plan (Appendix H), and the engineer's cost estimate (Appendix I).

1.4. ENVIRONMENTAL SETTING

The following sections discuss the regional environmental setting, including topography and climate, ecology, geology, hydrology, and seismic setting.

1.4.1. Topography and Climate

Regional ground surface elevations range from 6,225 feet mean sea level (msl) at lake level to above 6,500 feet msl in the south. The current site surface is 35 to 45 feet above natural grade and ranges in elevation from 6,370 to 6,385 feet msl.

The climatic description of the site is based on weather data from the Tahoe Valley Airport and the Meyers Inspection Station. Average monthly low temperatures range from about 14 °F in December to about 40 °F in July. Average monthly high temperatures range from about 41 °F in January to about 78 °F in August (Western Regional Climate Center, 2006a).

Most of the precipitation at the site is in the form of snowfall during the winter months (between November and April). Average annual precipitation is about 42 inches, and average annual snowfall is about 200 inches. The average snow accumulation is about 33 inches during the winter months (Western Regional Climate Center, 2006b). The frost depth at the site is about 2.6 feet (Weston, 2007).

1.4.2. Ecology

The vegetation community near the site is lodgepole pine (*Pinus contorta*). Lodgepole pine typically forms open stands of similarly sized specimens in association with few other species and with a sparse understory. Lodgepole pine stands have low structural diversity and are relatively low in animal species (Tetra Tech EM Inc. [TtEMI], 2001).

A search of the California Department of Fish and Game (CDFG) Natural Diversity Database was conducted to identify potential threatened and endangered species that may occur at the subject site. CDFG search results indicated that no state or federal threatened or endangered species are known to be associated with the habitat present at the landfill. Two Forest Service-sensitive species for the LTBMU have been observed near Meyers Landfill during yearly Forest Service protocol surveys (1997 to 2000): the Northern goshawk (*Accipiter gentillis*) and California spotted owl (*Strix occidentalis occidentalis*). The Northern goshawk was about 2.5 miles from the landfill, and the spotted owl was reportedly 1.5 miles away. Both species were reported in the same locations all four of the survey years (TtEMI, 2001).

1.4.3. Geology

The site is located in Lake Valley, which was created by a combination of tectonic and glacial processes. Basin and range extension created the fault-bounded Lake Tahoe Basin between the Sierra Nevada and the Carson ranges. The down-dropped Tahoe block is bordered on all sides by faults, including the North Tahoe-Incline fault, the West Tahoe-Dollar Point fault, and the East Tahoe fault zone. Individual faults of the East Tahoe fault zone are located within 3,000 feet north and south of the site (Weston, 2007).

The valley floor is made up of basin-fill deposits that generally consist of unconsolidated glacial, lake, and stream sediments. Bedrock in the area of the site was encountered at a depth between 150 and 228 feet bgs (Weston, 2007). The aquifer beneath the site is composed primarily of glacial deposits (poorly sorted deposits of clay- to boulder-size material, with moderate permeability) and stream and lake deposits (fine-grained silt and clay interbedded with moderately sorted high-permeability sands and gravels).

Based on previous investigations, the current landfill cap is composed of fine-to-medium sand and sand with silt that is loose and highly permeable. The landfill cover material is on average 5 to 6 feet thick, but it ranges from approximately 3 to 15 feet thick across the interim cover (Weston, 2007). A subsurface clay layer is located on the southwest side of the landfill that acts as an aquitard, creating perched groundwater zone along the southwest side of the landfill area (Weston, 2007).

1.4.4. Regional and Local Hydrology

The site is located in the Tahoe Valley South Groundwater Subbasin, identified by the California Department of Water Resources (DWR) as Groundwater Basin Number: 6-5.01, which occupies 23 square miles. The subbasin is part of the Tahoe Valley Groundwater Basin and is within the larger structural feature commonly referred to as the Lake Tahoe Basin (DWR, 2004).

The principal aquifer in the Tahoe Valley South Subbasin is Tertiary and Quaternary age glacial, fluvial, and lacustrine sediments, collectively referred to as basin-fill deposits. Most water wells drilled in the basin are completed in basin-fill deposits, where groundwater occurs under confined, semiconfined, and unconfined conditions. Hydraulic conductivity at the site is highly variable, but appears to range from approximately 20 to 60 feet per day. Pre-Cretaceous granitic rocks form the base of the aquifer. Seasonal changes in groundwater elevations in site monitoring wells indicate that groundwater recharge is primarily through direct infiltration of precipitation. Groundwater flow is toward Saxon Creek and then trends northward toward Lake Tahoe (DWR, 2004; Weston, 2007).

The Upper Truckee River flows north along the entire length of the subbasin and drains into Lake Tahoe. The river is joined by Grass Lake Creek and Big Meadow Creek near the southern end of the subbasin, Angora Creek centrally, and Trout Creek near the northern extent of the subbasin. Saxon Creek is located east of the landfill and is a main tributary to the Trout Creek watershed. Saxon Creek joins Trout Creek approximately 0.5 mile north of the landfill. The approximate drainage area of Saxon Creek is 8.2 square miles (Rowe and Kip, 1996). Average annual precipitation in the subbasin ranges from 23 to 49 inches, increasing from north to south (DWR, 2004).

The site lies within the South Tahoe Hydrologic Area as defined by the Water Quality Control Plan for the Lahontan Region (Basin Plan) (Lahontan Regional Water Quality Control Board [LRWQCB], 1995). The existing and potential beneficial uses identified for Saxon Creek include municipal, agricultural, groundwater recharge, commercial and sport fishing, contact and noncontact water recreation, cold freshwater habitat, wildlife habitat, migration of aquatic organisms, and spawning, reproduction, and development. The designated beneficial uses of groundwater in the basin include municipal, agricultural, and industrial service water supply.

1.4.5. Seismic Setting

Faults located within the vicinity of the site include those bounding Lake Tahoe Basin; the North Tahoe-Incline Village faults, the West Tahoe-Dollar Point fault zone, and the East Tahoe fault zone. The East Tahoe fault zone is closest to the site, and individual faults within the zone are located within 3,000 feet north and south of the site. A fault map illustrating the major faults within the area is presented in Figure 3.

The peak ground acceleration (PGA) for earthquake activity in the vicinity of the site is 0.5 to 0.6 gravity (g) with a 2 percent probability of exceedance in 50 years (Petersen et al., 2008).

1.5. HISTORIC, CURRENT, AND FUTURE LAND USE

The Meyers Landfill was operated as a municipal landfill between 1947 and 1971, after which it was covered with 2 to 4 feet of soil. The landfill also operated as a burn dump until the 1960s. The total volume of waste is estimated to range from approximately 290,000 cubic yards (Phase Three Environmental Management [PTEM], 2000) to approximately 305,000 cubic yards (Weston, 2007). An asphalt batch plant was built adjacent to the landfill (Figure 2). The batch plant permit was valid from 1972 to 1992, but the length of operation of the batch plant is unknown. A South Tahoe Public Utilities District (STPUD) sewer trunk line runs along the eastern edge of the landfill.

The site is located within the Tahoe Valley Management Area in zones designated as Developed Recreation and Reduced Timber Harvest areas (Forest Service, 1988). While no specific reuse plan has been established for the site, the following general definitions of "Developed Recreation" and "Reduced Timber" are provided in the Forest Plan:

- Developed Recreation (Prescription #1):

  "*Construct, maintain and operate recreation facilities. Assure an attractive and usable forest setting within and surrounding existing sites. Manage vegetation to insure a healthy forest, to prevent and/or reduce pest-related damage, and to reduce numbers of mechanically defective trees. Manage potential recreation development sites so that they remain suitable until they are utilized for recreation improvements. Other activities may be allowed on the undeveloped sites or within existing developed sites where they do not conflict with the primary emphasis on developed recreation. The visual quality objective is Partial Retention when viewed as middle-ground and Modification or better when viewed as foreground. The preferred ROS setting [Recreation Opportunity Setting] is Rural or Roaded Natural.*"

- Reduced Timber Harvest (Prescription #11):

  "*Apply group selection and single tree selection harvest practices to achieve wildlife habitat diversity and a high timber yield over the long term while protecting water quality and providing high quality dispersed recreation opportunities. Opening size produced by group selection will average about 1 to 2 acres but will not exceed 5 acres. Yields from regenerated stands will be approximately 70% of maximum. Openings will benefit early successional stage species such as deer and quail and will increase diversity from the predominantly medium-aged trees in the basin. Existing roads may be reconstructed to meet water quality protection standards and to enhance recreation access, including opportunities. Some temporary roads may be constructed for accessing timber. The visual quality objective is Partial Retention. The preferred ROS setting is Roaded Natural.*"

The landfill area is currently closed to public access, subsequent to an area closure order placed in 1999 by the Forest Service to implement removal actions under CERCLA. Although the area is officially closed, recreational off-highway vehicles (OHVs), including snowmobiles, dirt bikes, and all-terrain vehicles, are known to use the surface of the current landfill cap throughout the year. Future land use is governed by the LTBMU Forest Plan. The Forest Service expects to maintain closure status on the property; however, it is understood that without significant additional enforcement resources, the area will likely remain popular for unauthorized OHV recreational use.

1.6. PREVIOUS INVESTIGATIONS AND SITE CHARACTERIZATION

The following sections summarize the previous investigations and the sources and nature and extent of contamination at OU-1 that were identified based on results of previous investigations.

1.6.1. Previous Investigations

The Forest Service, City of South Lake Tahoe (City), and the County have conducted studies at the site from 1975 to the present. Table 1 summarizes the results of previous investigations conducted for the site.

1.6.2. Nature and Extent of Waste

Surface features on the landfill area include the access road, storm water drains, drainage ditches, and water collection galleries (Figure 2). The only structures on the landfill are Forest Service groundwater monitoring wells and manholes associated with the STPUD Trout Creek trunk sewer line that runs beneath the eastern side of the waste disposal area (Figure 2).

Consistent with the U.S. Environmental Protection Agency's (EPA) presumptive remedy guidance (EPA, 1993), the Forest Service has not characterized the contents of the landfill. The distribution of the buried waste is approximately 11 acres (Weston, 2007). The bottom of the waste fill appears to be at an average depth of approximately 25 feet below grade, with waste in the central portions of the site reaching depths of up to 50 feet. Site characterization efforts indicated that the waste volume is approximately

290,000 cubic yards to 305,000 cubic yards (Weston, 2007). The nearest residences are located approximately 1,500 feet north on Hekpa Drive and 1,100 feet west of the site on Busch Way.

The cover soil overlying the waste mass is composed of permeable silty sand and sand, and does not adequately restrict downward migration of precipitation (PTEM, 2000).

1.6.3. Waste Characteristics

Debris observed in the trenches excavated during previous investigations consisted mainly of household waste including bottles, cans, paper, plastic, wood (lumber), yard trimmings (branches and logs), wire, metal debris, and articles of clothing. Also observed were washing machines, water heaters, insulation, tractor tires, car batteries, carpet, textiles, insulated and bare wire (copper and steel), and car parts. The waste at all locations was observed to be mixed with soil. Soil within the waste typically ranged from 30 to 60 percent of the total volume and varied from area to area. Waste observed in the trenches did not appear to have been burned in place, although abundant burned debris was present in all trenches. The waste was typically moist and highly permeable (Weston, 2007).

1.6.4. Nature and Extent of Contamination

Volatile organic compounds (VOCs), primarily methane, hydrogen sulfide and vinyl chloride have been detected in groundwater, surface water, and LFG at the site (Weston, 2007). Concentrations of vinyl chloride in groundwater exceed Safe Drinking Water Act maximum contaminant levels (MCLs) for the State of California (Weston, 2007). Vinyl chloride is the predominant VOC present in groundwater and has been established as the main chemical of concern (COC) for the site.

The primary transport mechanism of VOCs from the landfill to groundwater is the percolation of precipitation, particularly water from melting snow, through the porous landfill cap to the shallow aquifer underlying the waste. Vapor phase transport of VOCs may also contribute to groundwater contamination (Weston, 2007).

Concentrations of vinyl chloride detected in surface water samples from Saxon Creek are below the California MCL for drinking water of 0.5 microgram per liter, and vinyl chloride has not been detected in Saxon Creek since 2000 (Weston, 2007).

VOCs in soil and landfill waste have been fully delineated both laterally and vertically (Weston, 2007). Results of soil vapor sampling at the site indicated VOCs in soil outside of the boundaries of the landfill are below concentrations of concern (Weston, 2007).

A French drain was installed on the west side of the landfill in 1976 to address the flow of water from a spring (due to the perched water zone on the west side of the landfill). Recent investigations indicated that the existing French drain is only partially effective in controlling the zone of perched water and should be repaired or replaced (Weston, 2007).

1.7. PRE-DESIGN INVESTIGATION RESULTS

Following a review of previous investigations for the site, ERRG concluded that the following parameters necessary to developing the RD had not been evaluated in previous studies:

- Evaluation of the potential borrow material
- Stormwater infiltration rate of the native material
- Geotechnical analysis of the subsurface conditions for design inputs
- Chemical analysis of the existing cap material

ERRG conducted a pre-design investigation on July 24 and 25, 2008, in support of the RD to address these data gaps (Appendix B). The purpose of the pre-design investigation was to evaluate subsurface geotechnical properties, site drainage, and existing site conditions in support of the RD. This work was completed in accordance with the Remedial Design Work Plan (ERRG, 2008).

ERRG completed two test pits (ML-TP-01 and ML-TP-02), four shallow infiltration test pits (ML-TP-01 PERC-1, ML-TP-01 PERC-2, ML-TP-02 PERC-1, and ML-TP-03 PERC-1), and two borings (ML-SB-01 and ML-SB-02). Soil samples were collected from both the test pits and the borings to evaluate the physical characteristics of the site subsurface. ERRG also collected grab samples from two locations (ML-GS-01 and ML-GS-02) on the existing cap to evaluate physical and analytical properties of the cap material. The locations of the test pits, borings, and grab samples are shown on Figure 4.

Based on the subsurface material observed during the pre-design fieldwork and data from previous investigations, the site is underlain with predominantly poorly graded sand (SP), silty sand (SM), and well-graded sand with silt (SW-SM). During the test pit excavations, the native soil east of the landfill, in the potential borrow area, was observed to be easily rippable. The infiltration rates for the native material along the planned drainage swale were found to be high enough to reduce the amount of runoff from the 100-year storm event by 46 percent through surface water infiltration (see Surface Water Calculation in Appendix C)

Laboratory geotechnical analysis was performed on the native material to evaluate the suitability of the material. The following properties of the native soil were established through these tests (Appendix B):

- Nonplastic and sandy in nature with minimal fines; minimizes probability of cracking due to desiccation
- Low silt content; helps prevent erosion problems
- Good drainage; water will flow freely through the cover system to the drainage layer
- Good frictional resistance; increases slope stability

The native sands encountered on the eastern side of the landfill were determined to be suitable for use in construction of the multilayer cap, as part of the foundation material and cover layers.

Prior to use in the vegetative layer, native soils would require further testing to evaluate the required nutrient additives to support vegetation. For the most part, subsurface soils were found to be granular and of poor quality for a vegetative cover layer without supplementation, except for dark brown SM observed in ML-TP-02 and ML-SB-02. This material may have originally been an on-site compost pile and may be acceptable for vegetative material without the addition of nutrients; however, the available volume of this material is unknown.

Asphalt was also observed in ML-TP-02, ML-TP-01 PERC-1, and ML-TP-01 PERC-2 at approximately 4 feet bgs. The extent of the asphalt is unknown, but may represent a former access road. Since the eastern edge of the plateau is proposed for use as a borrow area, asphalt will be avoided during excavation of this area to ensure clean borrow material.

Samples of the cover material were analyzed for CAM 17 metals, VOCs, polycyclic aromatic hydrocarbons, organochlorine pesticides, and total petroleum hydrocarbons as diesel and gasoline. All chemicals analyzed, except for arsenic, were either detected at very low concentrations or were not detected. Arsenic was the only chemical that was detected at a concentration exceeding its regional screening level (RSL) for industrial soil (EPA, 2008); however, the maximum concentration detected (1.7 milligrams per kilogram) corresponds to the low end of the range of background arsenic concentrations in California and the sierra region (Bradford et al., 1996; U.S. Geological Survey, 1984). These findings confirm that the cap soil does not contain any COCs and is chemically suitable for use as cap construction material.

A complete presentation of pre-design investigation results is provided in Appendix B.